$$x=\frac{m}{2R}\log\left[\frac{mg-RV^2}{mg-Rv^2}\right].$$

$$\therefore v^2=\frac{mg}{R}(1-e^{-(2Rx/m)})+V^2e^{-(2Rx/m)}.$$

For the velocity at the surface of the lake, $R=R_1$, $V=0$, $x=h$, $v=v_1$.

$$\therefore v_1^2=\frac{mg}{R_1}(1-e^{-(2h/m)})\ldots(5).$$

For velocity at bottom of lake, $x=l$, $V=v_1$, $R=R_2$, $v=v_2$.

$$\therefore v_2^2=\frac{mg}{R_2}(1-e^{-(2l/m)})+v_1^2e^{-(2l/m)})\ldots(6).$$

Following Rankin: $R_1v^2=\dfrac{kAe_1v^2}{2g}$, $R_2v^2=\dfrac{kAe_2v^2}{2g}$.

$\therefore R_1=\dfrac{0.51\,\pi\,r^2g\,\delta}{2g}=.0000008$; $R_2=\dfrac{0.51\,\pi\,r^2g}{2g}=.000618.$

Since $h=500$, $l=40$, we get: from (5), $v_1=162.447$ feet; from (6), $v_2=10.0564$ feet; from (3), $T=5.814$ seconds; from (4), $T_1=1.773$ seconds. $T+T_1=7.587$ seconds$=$total time. These results would be slightly changed for different values of R_1, R_2.

NUMBER THEORY AND DIOPHANTINE ANALYSIS.

NOTE ON PROBLEM 152.

On referring to the memorandum book from which the problem was taken, I find that p is prime, for which case the theorem would appear to be true. PROPOSER.

155. Proposed by R. D. CARMICHAEL, Anniston, Ala.

If p and q are primes and m and n are any integers, find the cases in which the equation $p^m-q^n=1$ may be satisfied.

Solution by the PROPOSER.

Some values, found by inspection, are given by Zerr in the MONTHLY for December, 1908. A complete solution may be effected by aid of the following lemma (see *Annals of Mathematics*, Vol. 8, No. 4, p. 15).

If x is a positive integer >1, x^t-1 has a prime factor not dividing x^u-1 $(u<t)$, except in the cases $t=2$, $x=2^v-1$, $v\overline{\gtrless}2$; $t=6$, $x=2$. Such prime